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(54) MOLYBDATE-AMINE CORROSION INHIBITOR

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No. OF CLAIMS 13 - NO DRAWING

MOLYBDATE-AMINE CORROSION INHIBITOR

Abstract of the Disclosure

A composition comprising a molybdate and an amine, preferably with a benzotriazole or the like added to circulating closed water systems to inhibit corrosion.

WE, CLAIM:

1. A corrosion inhibitor for closed aqueous systems comprising at least one molybdate and at least one amine.
2. The inhibitor of Claim 1 wherein the molybdate is sodium molybdate.
3. The corrosion inhibitor of Claim 2 wherein said amine is selected from the group consisting of morpholine, ethylene diamine, and 2-amino-2-methyl-1-propanol.
4. The inhibitor of Claim 3 wherein the amine is morpholine...
5. The inhibitor of Claim 3 wherein the amine is ethylene diamine..
6. A corrosive inhibitor for closed aqueous systems comprising at least one molybdate, at least one amine, and at least one supplementary inhibitor.
7. The corrosive inhibitor of Claim 6 wherein said molybdate is sodium molybdate, said amine is selected from the group consisting of morpholine, ethylene diamine, and 2-amino-2-methyl-1-propanol; and said supplementary inhibitor is selected from the group consisting of benzotriazole, sodium polymethacrylate, and a copolymer of sulfonated polystyrene and maleic anhydride.
8. The inhibitor of Claim 7 wherein the supplementary inhibitor is benzotriazole.
9. The inhibitor of Claim 7 wherein the supplementary inhibitor is sodium polymethacrylate.
10. The inhibitor of Claim 7 wherein the supplementary inhibitor is a copolymer of a sulphonated polystyrene and maleic anhydride.

DISCLAIMER - RENOUCLATION

11. A method for inhibiting corrosion in closed aqueous systems which comprises introducing into said systems at least one molybdate and at least one amine.

12. The method of Claim 11 wherein said molybdate is sodium molybdate.

13. The method of Claim 12 wherein said amine is selected from the group consisting of morpholine, ethylene diamine, and 2-amino-2-methyl-1-propanol.



This invention relates to an improved corrosion inhibitor for closed water systems.

The prior art is replete with supposed inhibitors, many of which are characterized by major defects. Some of these for instance are susceptible to loss of effectiveness or breakdown due to air leakage into the water system. In this way inhibitors containing hydrazine react with oxygen and not only lose their effectiveness, but also, in many hot water heating systems tend to produce ammonia which, in the presence of oxygen, causes severe corrosion of copper and copper alloys.

Other inhibitors are susceptible to biological degradation which is a fairly common occurrence with borate-nitrite based formulas.

Some inhibitors are considered serious pollutants if a leak occurs. This is true of chromates and hydrazine. The chromates also have an undesirable yellow color and tend to stain.

Many of the prior art inhibitors require a high inorganic solids content which greatly increases the objectionable solid build-up where leaks have developed in the system and affect the performance of pump seals.

Many of the inhibitors are also incompatible with ethylene glycol treated systems.



Some inhibitors which are satisfactory for mild steel, tend to cause marked increases in corrosion rates on other metals and may produce undesirably high pH levels.

Others are degraded by heat or have various disadvantages.

In view of these various defects of the inhibitors of the prior art, it is an object of the present invention to develop a new and improved corrosion inhibitor for closed aqueous systems, which will also be satisfactory for such systems containing ethylene glycol.

A further object is an inhibitor which does not react unfavorably with oxygen or lose effectiveness, or produce corrosive effects in closed water systems, or with respect to copper and copper alloys.

An additional object is an inhibitor which is not susceptible to biological degradation, is not a serious pollutant and is non-staining.

A further object is an inhibitor which operates with a low solids content, gives full protection for conventional heat exchange metals, and is not degraded by heat.

Other objects will be appreciated from the following description of the invention:

The present invention is a new and improved corrosion inhibitor for closed water systems comprising at least one molybdate and at least one amine. These materials when mixed together and added to water inhibit the corrosion of metal in a water environment. Various combinations have been evaluated and corrosion rates determined. The results are excellent contrasted to those corrosion inhibitors known to the prior art.

In a preferred form of the invention a supplementary inhibitor is also added such as benzotriazole, sodium polymethacrylate, or a copolymer of sulphonated polystyrene and maleic anhydride.

Morpholine and ethylene diamine are preferred amines.

The invention is also valuable for use in closed aqueous systems to which ethylene glycol has been added.

It is also to be noted that the molybdate anion can be easily and accurately tested, using a simple color comparison test, whether the medium used is water or ethylene glycol and water.

As indicative of the results obtained, two types of tests were employed as shown in the following examples:

The first was a beaker test, in which the metallic coupons were stirred through a solution of the inhibitors in a tap water of medium hardness at room temperature for six days. In the second test, to evaluate the inhibitor under static conditions, the coupons were immersed in inhibited tap water in a closed nearly-filled bottle. The bottles were held at room temperature for two days, and then transferred to an oven at 70° C for a further 5 days. The following results illustrate the corrosion inhibition properties of the mixtures of sodium molybdate and amines:

<u>Composition</u>	<u>EXAMPLE</u> <u>Concentration</u>		<u>Corrosion Rate</u> <u>for mild steel (mpy)</u>	
	PPM		<u>Beaker</u>	<u>Bottle</u>
1. Sodium molybdate	75)			
Morpholine	152)		5.2	14.9
Benzotriazole	16)			
2. Sodium molybdate	160)			
Morpholine	200)		1.7	0.0
Benzotriazole	16)			
3. Sodium molybdate	250)			
Morpholine	200)		0.8	-
Benzotriazole	16)			

		<u>Beaker</u>	<u>Bottle</u>
4.	Sodium molybdate 220) Morpholine 200) Benzotriazole 16)	0.7	1.8
5.	Sodium molybdate 220) 2-Amino-2-methyl-1-propanol 200) Benzotriazole 16)	1.0	2.0
6.	Sodium molybdate 220) Ethylene diamine 100) Benzotriazole 16)	0.3	0.5
7.	Sodium molybdate 220) Morpholine 200) Benzotriazole 16) Sodium polymethacrylate 36)	-	0.6
8.	Sodium molybdate 330) Morpholine 300) Benzotriazole 24) Sodium polymethacrylate 54)	-	0.2
9.	Sodium molybdate 220) Morpholine 200) Benzotriazole 6) Sodium polymethacrylate 36)	0.9	2.0
10.	Sodium molybdate 440) Morpholine 400) Benzotriazole 12) Sodium polymethacrylate 72)	0.3	0.8
11.	Sodium molybdate 220) Ethylene diamine 100) Benzotriazole 6) Sodium polymethacrylate 36)	0.4	0.6
12.	Sodium molybdate 440) Ethylene diamine 200) Benzotriazole 12) Sodium polymethacrylate 72)	0.2	0.2
13.	Sodium molybdate 200) Ethylene diamine 100) Benzotriazole 6) Sulphonated polystyrene maleic anhydride copolymer 9)	0.3	0.4

Benzotriazole is found to be an inhibitor for copper and copper alloys and, therefore, enhances the corrosion inhibiting properties of this formula.

Low molecular weight sodium polymethacrylate was included in the later formulations for the following reasons:

a) It is found to inhibit, retard or prevent objectionable scale formation on high temperature heat exchange surfaces, as would be found in hot water heating systems using unsoftened make-up water.

b) It also is found to retard crystal growth of calcium, magnesium and iron deposits. These crystalline deposits have proved to be objectionable, and are detrimental to the performance of pump seals.

3. The sulphonated polystyrene/maleic anhydride copolymer was tested as an alternative to the sodium polymethacrylate.

Some of the above combinations were evaluated as corrosion inhibitors for metals other than mild steel, with the following results:

<u>Treatment</u>	<u>Level</u>	<u>Metal</u>	<u>Corrosion Rate (mpy)</u> <u>Beaker</u>	<u>Bottle</u>
4. Sodium molybdate	200)	Copper	0.3	-
Morpholine	200)	Admiralty brass	0.3	-
Benzotriazole	16)	Aluminum	1.4	
11. Sodium molybdate	220)	Copper	0.4	-
Ethylene diamine	100)	Aluminum	3.5	2.0
Benzotriazole	6)			
Sodium polymethacrylate	36)			
12. Sodium molybdate	440)			
Ethylene diamine	200)	Copper	0.4	-
Benzotriazole	12)	Aluminum	8.0	5.6
Sodium polymethacrylate	72)			
9. Sodium molybdate	440)			
Morpholine	400)			
Benzotriazole	12)	White brass	0.1	1.6
Sodium polymethacrylate	72)	Aluminum	2.1	9.9
10. Sodium molybdate	440)			
Morpholine	400)	White brass	0.1	1.6
Benzotriazole	12)	Aluminum	2.1	9.9
Sodium polymethacrylate	72)			

The preferred treatment is No. 9 (and No. 10, which is a double dose of No. 9), in that it is less aggressive towards aluminum in a flowing system than the formula based on ethylene diamine instead of morpholine (No. 11 and No. 12).

Finally, corrosion rates, using treatments No. 9 and No. 10, were determined for mild steel using 50% ethylene glycol, 50% tap water as the cooling medium. The rates were as follows:

Treatment No. 9	0.4 mpy (beaker) & 1.0 mpy (bottle)
Treatment No. 10	0.4 mpy (beaker) & 0.3 mpy (bottle)

These results indicate that the same inhibition of corrosion can be achieved in ethylene glycol/water mixtures as can be achieved in water alone.

It will be appreciated that many variations can be made without departing from the principles of the invention.

SUBSTITUTE
REMPLACEMENT

SECTION is not Present
Cette Section est Absente